

NORTHEASTERN FOREST EXPERIMENT STATION

Division of Watershed Management Research

Semi-annual Report

April 1956

GENERAL

This last six months went by in about six weeks. Specific accomplishments are given in Irv Reigner's, Sid Weitzman's, and Dick Trimble's reports from their respective centers. Viewing their work from the elevation of Upper Darby (whose altitude is a few hundred feet lower than most everything in the Northeast) gives a more diffused perspective. Viewed thus, at Kingston, Reigner and Eschner are concentrating on calibration of Dilldown and preparation of a number of papers from Dilldown data before turning their attention to development of a research program of greater scope in their area. For this latter objective, a problem analysis was worked out and given Washington office, Region 7, and in-Station review.

At Mountain State, Sid Weitzman, Ken Reinhart, and Burley Fridley are also juggling calibration data, and are launching into new work. The Fernow's five watersheds were increased to seven last fall and two more will be added this year. On-watershed plots studies of soils and soil-moisture under calibration conditions are being started.

Trimble, Sartz, and Pierce keep busy doing at one and the same time the job of problem analysis and program development, building weirs, and initiating first studies of White Mountain factors influencing streamflow.

A number of papers involving assistance from Upper Darby have reached and lingered in the rough-draft stage since our last report. These include a report on results of our soil moisture study at the Lebanon Experimental Forest in New Jersey, a review of literature on forest and range soil compaction, a comparison of streamflow from essentially forested and cropland watersheds using Geological Survey data, and a review of the role of forest humus in watershed management.

KINGSTON RESEARCH CENTER

How Rainfall Affects Groundwater

Ordinarily, in this region of well-distributed rainfall, groundwater levels follow a nice routine. They are high during the winter, fall during the summer and early autumn, then begin to rise after leaf fall and the coming of cooler weather.

But during the past eight months, this pattern has been almost reversed, the result of rainfall which has NOT been well distributed. Early last August, groundwater was normally low for that time. Along came those two wet hurricanes, Connie and Diane, which dumped tremendous quantities of water on the Pocono Mountains. Consequently, groundwater rose to the extreme high levels usually attained after heavy winter storms. So groundwater remained high during late summer and autumn, reaching a record high in October after another large storm.

Then, however, rainfall slacked off--November was drier than normal and during December was a record low, less than $3/4$ of an inch in the Poconos. January was also very dry, about $1\frac{1}{2}$ inches. As a result, by the beginning of February, groundwater had fallen to low levels expected only during the summer months. Since then, there has been considerable snow and rain, raising groundwater to normal spring levels.

This has been an excellent example of the way groundwater is influenced by rainfall.

Watershed Calibration

Although harassed by the numerous reports, performance ratings, and other deadlines that occur in the first quarter and which appear to be so unfruitful to a researcher, we were able to devote a considerable amount of time to the calibration analysis of the Dilldown watershed. We have made a rather thorough study of the monthly relationships discussed in the previous quarterly report. Many ideas and admittedly numerous blind alleys were investigated as completely as possible. Progress in improving the relationships has been gradual but continual - a very gratifying situation.

One of the things we found is that average monthly temperature is better related to monthly streamflow than is monthly saturation deficit. Although theoretically the latter should have more influence than straight temperature, statistically the temperature factor removes considerably more of the variation.

It was also discovered that the combination of the three independent variables, monthly precipitation, antecedent precipitation, and a temperature factor resulted in a curvilinear expression of monthly runoff. This curvilinearity was removed by putting the dependent variable on a log scale. Although the relationship was considerably improved, the logarithmic expression of the dependent variable caused certain disadvantages, particularly in expressing the standard error of estimate.

As the latter is a very necessary product of this analysis, we searched for a method to eliminate the curvilinearity. None of the independent variables appeared to have a curvilinear effect, but a ratio interaction, Precipitation/Temperature, straightened the relationship and furthermore eliminated the precipitation term.

We are at this point at present, and have attained a standard deviation from regression of 0.37 inch. We feel certain this can be refined still further.

Physical Properties of Some Northeastern Soils

A rough draft of a station paper summarizing the physical properties of some northeastern soils, studied by the Vicksburg Infiltration Project, has just been completed by Art Eschner. In addition to presenting the data in a table, he has tried to uncover some relationship between bulk density and texture and organic matter content. Organic matter content appears to be strongly correlated with bulk density; clay is of less importance; and sand even less.

Scrub Oak Conversion

Plans are all set for the planting of the 35 acre area on the Dilldown watershed that was prepared last fall by root rake.

From time to time, various interested persons have suggested the use of explosives to prepare planting sites in scrub oak areas. Their idea was to blow out the scrub oak crowns and expose mineral soil in planting spots or in strips. Accordingly, the idea was investigated in January. A thin layer of frost, one to two inches thick, was considered more help than hindrance, thinking that a greater surface area would be exposed. Unfortunately the experiment was not successful. The holes produced by the explosion were too deep and not large enough in area; the finer soil particles were lost and the rocks remained. Even had the planting spot been suitable, the time involved in placing the explosives and stringing the wires would make the procedure impractical.

Visitors

With just a one-day notice, Reigner was asked to show a group of U. S. Geological Survey men around the Dilldown project. Those attending were Jim Culbertson, Engineer in Charge of the Water Quality Branch in Philadelphia, and W. V. Irons, Rivermaster of the Delaware River at Milford, Pa. Malcolm P. Crooks from western New Jersey also attended the trip.

MOUNTAIN STATE RESEARCH CENTER

Soil-Moisture Study

A working plan has been prepared for a soil-moisture and humus study to start this spring on our 5 gaged watersheds. Our main objective is to gather information to assist in interpreting any changes in stream-flow measured at the weirs after the watersheds are cut according to different practices. Soil moisture will be measured gravimetrically in this study.

Analysis of Calibration Period

A major problem at the moment is to determine when we can start cutting in the gaged watersheds. Analysis of stream-flow by months shows very good correlation between watersheds to be treated and the control and also appears to indicate that our calibration period (5 years) is now long enough. However, we are aware of the time-series objections to the use of monthly data. In so far as low discharge values are followed by low values because of a holdover effect from month to month, such objections appear valid and important. However, in so far as low values are followed by low values because 2 consecutive months both have low precipitation and high evapo-transpiration, the objections seem to lose much of their importance. Perhaps a statistical method can be devised to take the above factors into account. Any suggestions? We have a date in late April to talk this over with Hal Wilm.

Open-Land Watersheds

There are over $1\frac{1}{2}$ million acres of open land in West Virginia which should go back to trees. Two small abandoned-pasture watersheds, typical of this area, have tentatively been selected for study. During the calibration period, these watersheds will reveal the runoff characteristics of pasture as compared to forest land. Then emphasis will shift to determine the time it takes to rehabilitate such areas and the magnitude of changes in watershed characteristics brought about by rehabilitation.

Water Quality

Our studies of water quality, especially turbidity, are continuing. It becomes increasingly clear that stream turbidity is often seriously affected by material from road runoff long before the usefulness of the road is impaired.

Computations

One objective on the Fernow has been to keep streamflow and precipitation data computed and checked to within three months of the date collected. Burley Fridley, Forestry Aide, has for years been doing a fine

job of meeting this difficult but worthwhile objective. At the moment, due to pressure of events, we have temporarily, we hope, fallen slightly behind this objective. We believe that a policy of keeping abreast of computations and analysis is worth the struggle necessary to accomplish it.

WHITE PINE-HARDWOOD RESEARCH CENTER

As of the first week in April the Hubbard Brook Experimental Forest is still buried under a heavy blanket of snow. At elevations of 2500', a foot of snow water is lying on top of the ground. There is less at lower elevations but all over watersheds of the North Country hangs an ominous flood threat. A week of warm sunny days and cold nights could move a lot of snow water safely down the brooks, but a heavy rain at this time could trigger raging torrents. Fortunately, there is little, if any, concrete frost in the woods and not too much in open areas.

Throughout the winter we have carried on snow and ground freezing observations at Hubbard Brook in conjunction with the runoff and precipitation studies on the gaged watershed. We found, as was expected, that snow survey data could not be substituted for winter precipitation measurements in this country. "January thaws" and occasional rains throughout the winter period preclude total dependence on snow surveys. This winter, for example, about the middle of January we lost practically all of our snow below 2000 feet elevation. In that month we had several inches of precipitation in the form of rain. The weather got so warm that all of the ice went out of the pond behind the weir--and it was a foot and a half thick.

Our weir has given a continuous and excellent record of streamflow throughout the winter months. The only winterizing we have done is to use an oil tube for the float. Weekly we cut the ice back in a 2-foot semi-circle behind the V-notch to make sure of unimpeded flow when we checked the stage height on the chart. At times of extreme cold--subzero weather--flow over the notch was temporarily distorted by ice blocking or draw-down. These conditions shortly corrected themselves and chart corrections were simple and obvious.

We used Prestone to prevent freezing in our rain gages. This is easier to use and gives a more dependable and predictable protection against freezing than calcium chloride. We use oil for protection against evaporation. All winter precipitation measurements are made by weighing the catch.

Talks

Pierce presented a paper on the effects of land use on ground freezing in the Northeast to the annual meeting of the Eastern Snow Conference at Dartmouth.

Jensen and Trimble gave a radio talk in Greenfield, Massachusetts on the different aspects of watershed management in New England.

Trimble discussed watershed management problems before the annual meeting of the Massachusetts Forest and Parks Association in Boston.

Papers

"Snow storage and melt in a northern hardwoods forest" by Sartz and Trimble has been submitted for publication in the Journal of Forestry.

Visitors

George S. Cavadias, Hydrologist for the Shawinigan Water and Power Company in Montreal, Canada, spent a day in Laconia discussing the effects of land use on streamflow. The Shawinigan Company has large timberland holdings in their watersheds. This company is desirous of managing these forested watersheds to obtain optimum effects on streamflow. In their reservoir-building program they are aiming at a better distribution of flow throughout the year. They are studying ways of land use management to supplement their construction program.

PUBLICATIONS

Research on the Fernow Experimental Forest by Sidney Weitzman. Northeastern Logger 4(7): 14-15.

Chaff Seeding - One Answer to Soil Washing on Logging Roads by G. R. Trimble, Jr. and Sidney Weitzman. West Virginia Conservation 19(12): 12-13.